

Social Computing for Social Good in Low-Resource Environments

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Social Computing Revolution

Discussion Forums, Social Media Platforms, Crowdsourcing Marketplaces, Blogs, Wikis...



Literacy, Language, Socioeconomic, & Connectivity Barriers



781 Million
illiterate



2.5 Billion
speak low-resource languages



736 Million
live on < \$2/day



3.6 Billion
w/o connectivity

Great First Steps...

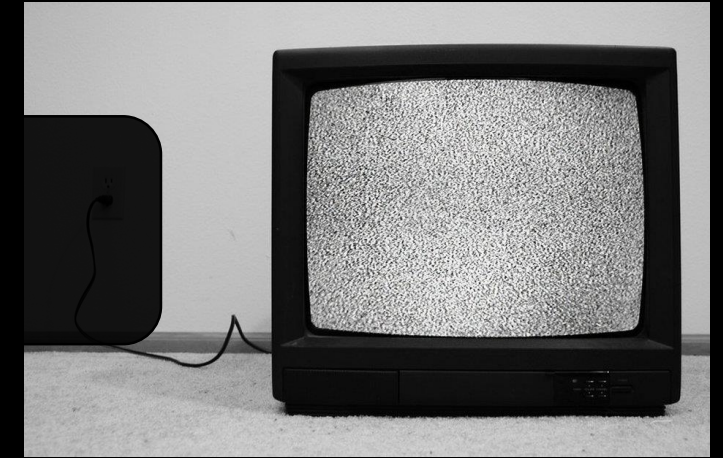
Facebook Aquila



Google Loon



Microsoft Airband



Connectivity

Sociocultural norms

Devices

Geopolitical environment

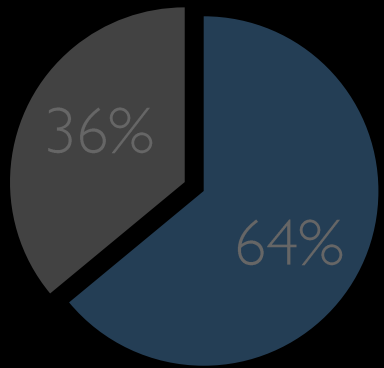
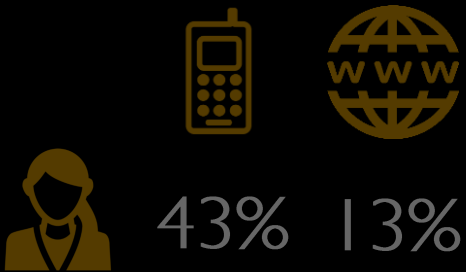
Energy and power

Literacy and language

Transport



■ Smartphone ■ Feature or Basic Phone



→ 100+ proprietary OS

Connectivity

Sociocultural norms

Devices

Very Difficult to Connect People in Low-Resource Environments

Geopolitical environment

Energy and power

Literacy and language

Transport

26% people illiterate

122 major languages but no models and data

No fonts for several languages

Goal: How to bring the benefits of social computing to billions of people who face literacy, language, socioeconomic, and connectivity barriers?



Connect



Information



Equity

Voice-based Social Computing Services Using IVR



To record an audio message, press 1.
To listen to others' messages press 2.



Overcoming Barriers



हिंदी

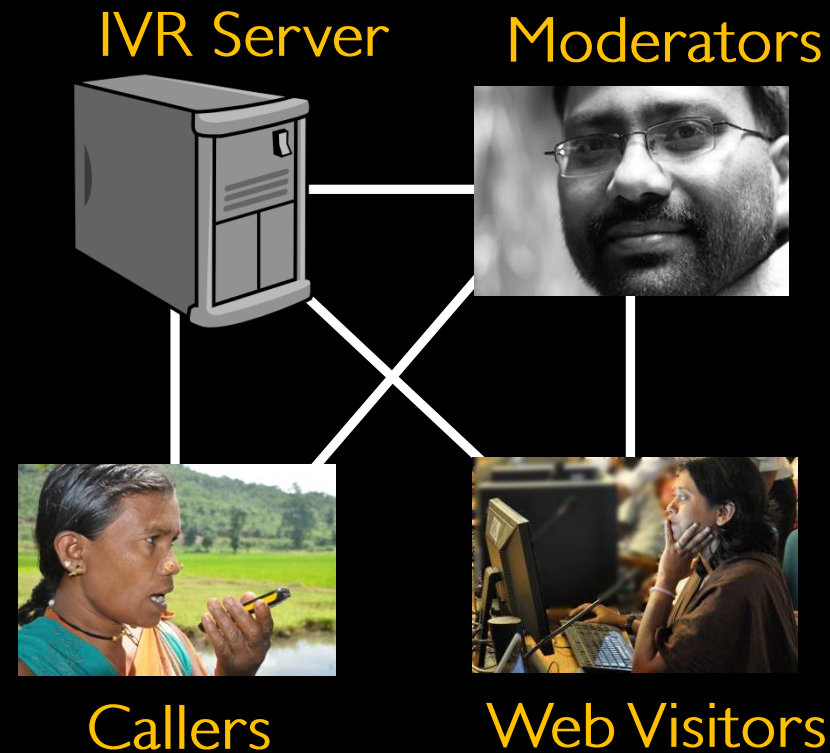


Chhattisgarh, India



CGNet Swara

A Voice Portal for Citizen Reporting



600,000 phone calls, 6,500 reports

Other Early Deployments

Avaaj Otalo in India



Peer sharing of agricultural information

Mobile Vaani in India



Enabling people to record and listen to stories from others

Ila Dhageyso in Somaliland



Connecting rural people and government officials

Voice-based Social Computing Services for Global Development

Health

Empowering Health Workers
Yadav et al. WWW 17

Real-time Health Radio Show
Azakou et al. CHI 15

Treatment of People with AIDS
Joshi et al. CHI 14

Agriculture

Agriculture Discussion Forum
Patel et al. CHI 10

ParAdvis System
Basa et al. APEC 13

Call-based Price System
Basa et al. APEC 13

Civic Engagement

Citizen News Journalism
Mudliar et al. ICTD 12

Engaging Marginalized People
Marathe et al. ICTD 15

Civic Engagement Portal
Gulaid and Vashista, ICTD 13

Chakraborty et al. ICTD 15

Millions of Calls and Voice Messages in Local Languages from Marginalized People

Employment

Job Ads by Entertainment
Raza et al. CHI 2013

Employment Exchange
White et al. ICTD 12

Social Computing

Agarwal et al. ICTD 09
Koradia et al. ICTD 12

Vashista et al. CHI 15
Raza et al. CHI 18

Vashista et al. CHI 19

MISC

Feedback on School Meals
Grover et al. DEV 12

Measure Knowledge Retention
Raza et al. CHI 19

Small-group Activity 1

Discuss and Identify five challenges that these voice-based services experience

Then, pick any one challenge and discuss ways to overcome it

Challenges of Voice-based Social Computing Services

Adoption

- Training users
- Spread
- Retaining users

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Scale

- Content Moderation
- Financial Sustainability
- Misinformation

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Broader Impact

- Measurement
- Replicability
- Inclusivity

How to create **scalable, sustainable, replicable, and impactful** voice-based social computing systems that can grow at the scale of large Internet websites?

Challenges of Voice-based Social Computing Services

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Adoption Hurdles

User Interface hurdle: How to train low-literate, non-tech-savvy people to use speech interfaces?

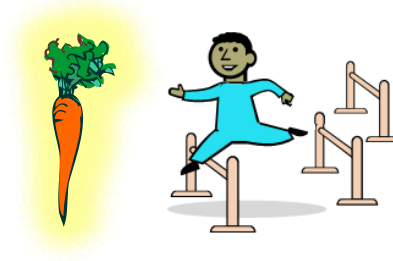
Motivation and trust hurdle: How to motivate and incentivize target populations to change their ways and practices?

Uptake and spread hurdle: How to spread the services to poorly connected masses?

Our strategy is ENTERTAINMENT

For Entertainment:

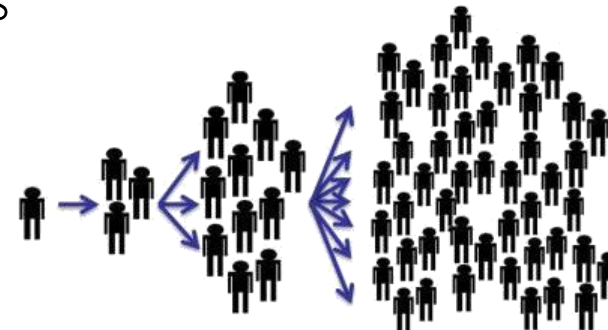
- Users overcome interface hurdles (Smyth et al. 2010)



- Users do not need any convincing



- Users spread the services to others



Our Strategy:

Use **Viral Entertainment** as a vehicle to disseminate
Development related information

Polly (میاں مٹھو)

Polly is a telephone-based, voice-based service which allows users to make a short recording of their voice, modify it and send the modified version to friends.



Job Audio-Browser



1. Scan Pakistani newspapers for jobs for low-skilled workers

Tags : Jobs in Pakistan, Lahore, Marketing Jobs, Sales Jobs

Driver Jobs in Lahore Based Industry

Posted by Jobs Careers 23 August, 2011 (0) Comment

Driver Jobs in Lahore Based Industry

[CLICK HERE TO VIEW DETAILS OF THIS JOB >>](#)

Categories : Helpers and Supporting Jobs in Pakistan, Jang Newspaper Jobs, Jobs in Lahore, Jobs in Pakistan, Newspaper Jobs Pakistan

Tags : Drivers, Jobs in Pakistan, Lahore

Ref: paperpk.com

ضرورت سیکورٹی گارڈز

- کم از کم تعلیم: میٹرک
- تنخواہ: -/12000 روپے ماہوار
- عمر کی حد: 25 سے 50 سال۔
- رہائش اور کھانا بھی دیا جائے گا۔
- آرمی سے ریٹائرڈ افراد کو ترجیح دی جائے گی۔

درخواست جمع کرانے کی آخری تاریخ 22 ستمبر، 2012 ہے۔

Email: guardsjoblhr@gmail.com

پتہ: P.O. Box 187 جنگ لاہور۔

© Jang Newspaper

2. Record these ads
3. Invite Polly's users to audio-browse them

Deployment in Lahore



Seeded with 5 users

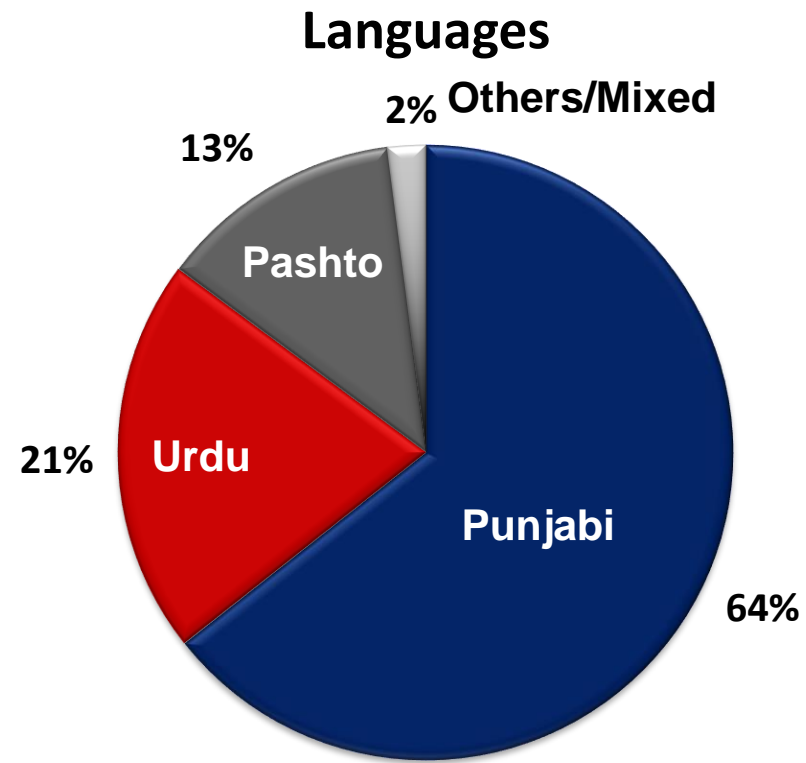
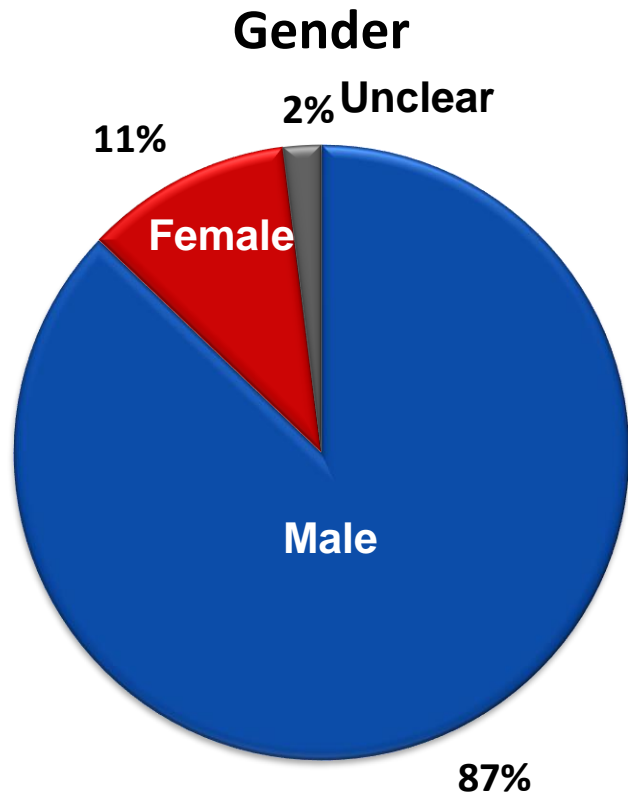
- Within a year
 - 636,000 calls
 - 165,000 users
 - Reached a rate of spread of 1,000 new people per day
- 34,000 people used the job search service
- listened 386,199 times to 728 job ads
- and 19,000 users forwarded them to their friends.

Raza et al. 2013, CHI, *best paper award*.

User Demographics



Determined by listening to a sample of recordings:

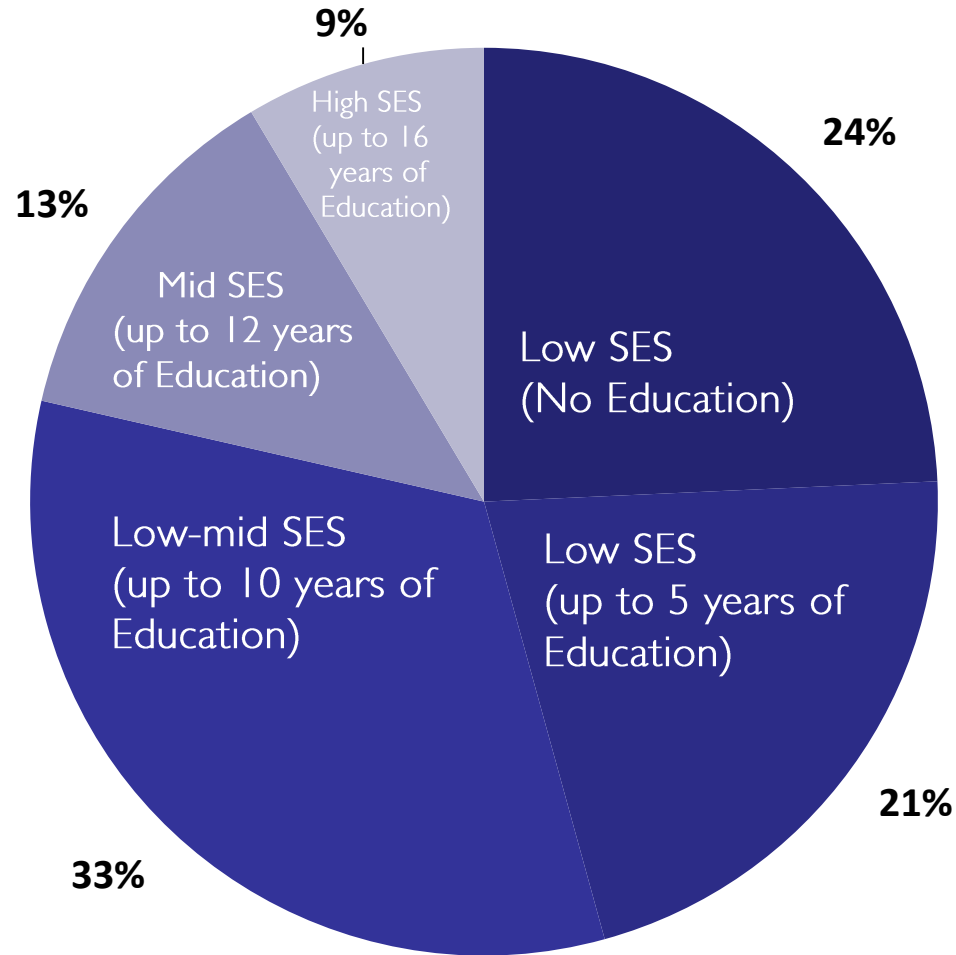


Used mostly by Punjabi speaking men...

User Demographics

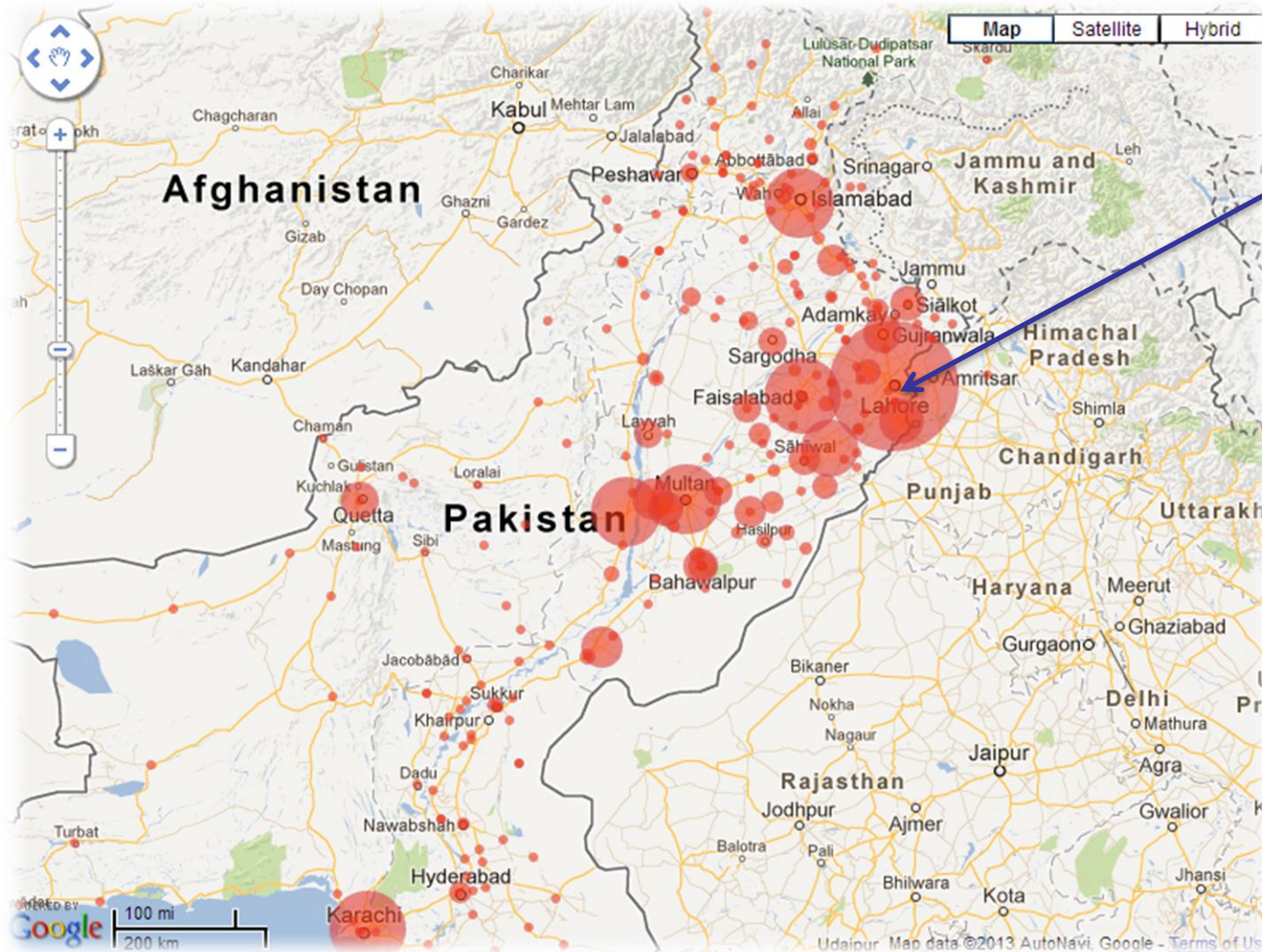
Estimated from 207 survey calls

Socio-Economic Status



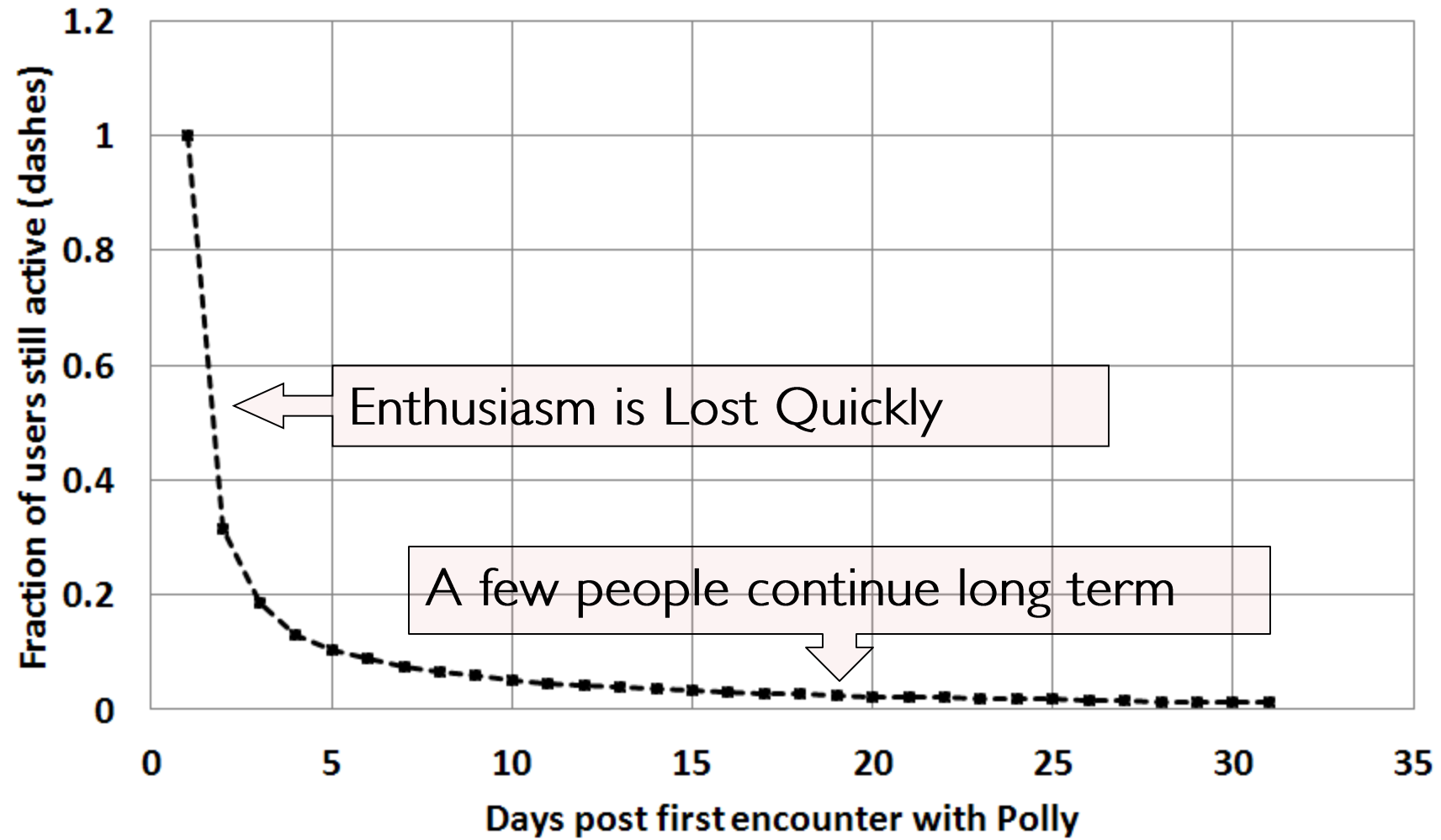
Primarily used by
low-educated,
low-income people

Geographical Spread



- Seeded in Lahore and Okara
- Reached all parts of Pakistan.
- And also a handful of calls from:
 - India
 - Belgium
 - Oman
 - Saudi Arabia
 - UAE

User Retention



How can we increase user retention?

Challenges of Voice-based Social Computing Services

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Scale

- Content Moderation
- Financial Sustainability
- Misinformation

Broader Impact

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- Inclusivity

Content Moderation Challenge



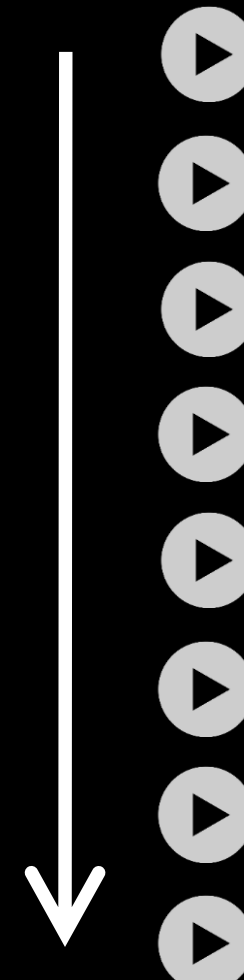
Voice-based Discussion Forum

Posted by u/mz3ns 5 hours ago
43.4k
Supreme Court of Canada says bankrupt energy companies must clean up old oil, gas wells before paying off creditors
thestar.com/calgar...
1.1k Comments Share Save ...

Posted by u/ManiaforBeatles 11 hours ago
34.3k
Labour complaint against Amazon Canada alleges workers who tried to unionize were fired - Union says the e-commerce giant violated Employee Standards Act
cbc.ca/news/b...
1.9k Comments Share Save ...

Posted by u/ppd322 6 hours ago
2.3k
Russia NRA Attempts To Distance Itself From Trip To Moscow In 2015
hillreporter.com/nra-at...
302 Comments Share Save ...

Posted by u/mvea 9 hours ago
4.6k
Microplastics found in every marine mammal surveyed in UK study. The research on 50 stranded creatures, including porpoises, dolphins, grey seals and a pygmy sperm whale, found an average of 5.5 particles in their guts, the most comprehensive analysis of microplastics in wild



Categorize
Review quality
Decide playback order

Managing User-Generated Content in Local Languages



10-15 Moderators



Generate meta tags



Review them

How to reach the scale of large Internet websites?

Key Idea: Enable Scaling through Community Moderation



RQ: Can marginalized users of these services moderate and categorize voice messages?

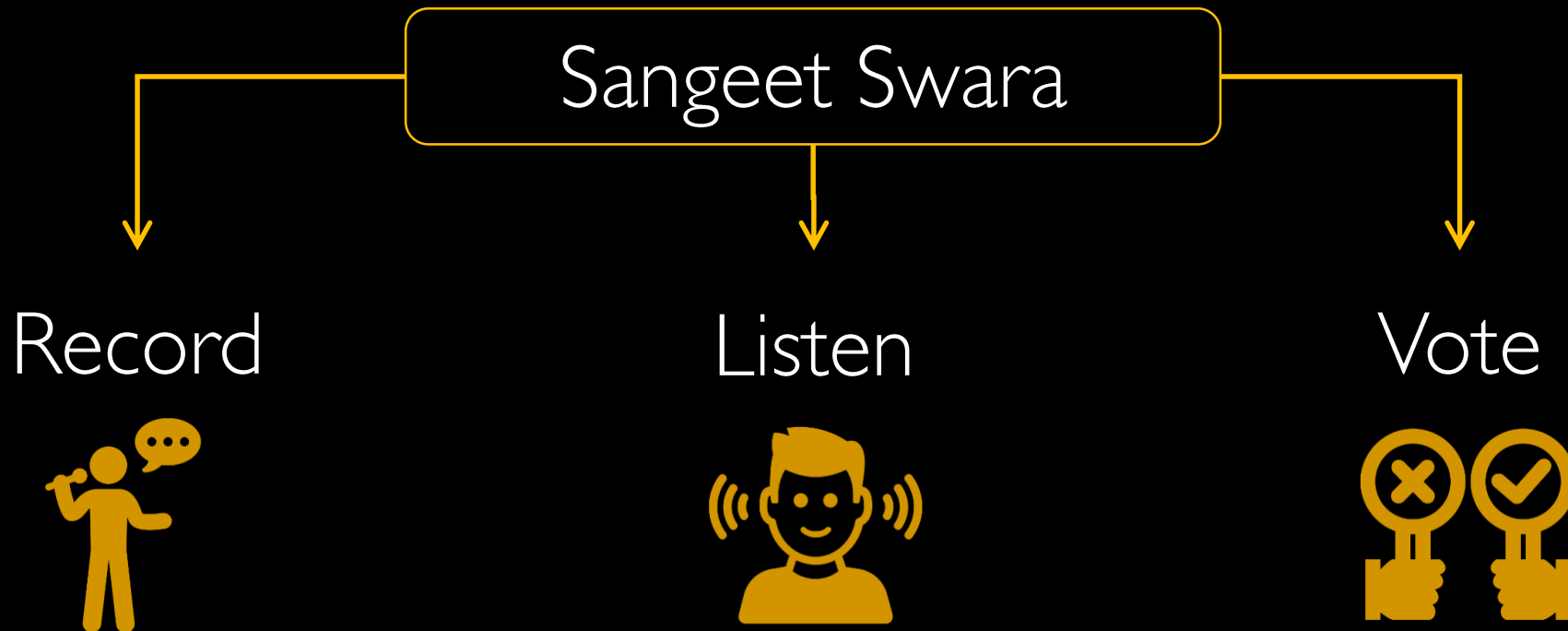


Novice users

Sangeet Swara

A Community-Moderated Voice-Based Social Media Service

 [Vashista et al. CHI 15, Best Paper Award]



Sangeet Swara

A Community-Moderated Voice-Based Social Media Service

 [Vashistha et al. CHI 15, Best Paper Award]

 1800-102-3690

Sangeet Swara Home Menu

1

Access Analytics on
Users' Messages

2

Record New Message

3

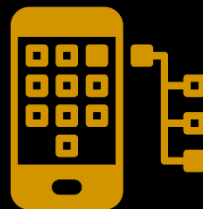
Listen to & Vote on
Messages

To share this message with friends, Press 4.

Community Moderation Algorithm for Voice Interfaces



vs.

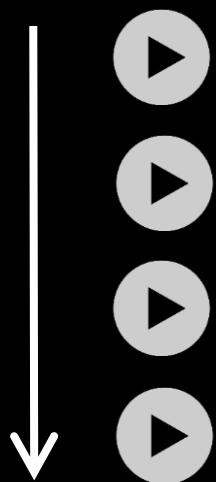


vs.



How to decide the playback order?

How to decide the quality of messages?



Balance of novelty & popularity

High score for messages with high ratio of upvotes to downvotes

High confidence in judgement

Deployment of Sangeet Swara in Rural India

Spread virally from 73 people to 1500+ by word of mouth

Traffic in 11 weeks

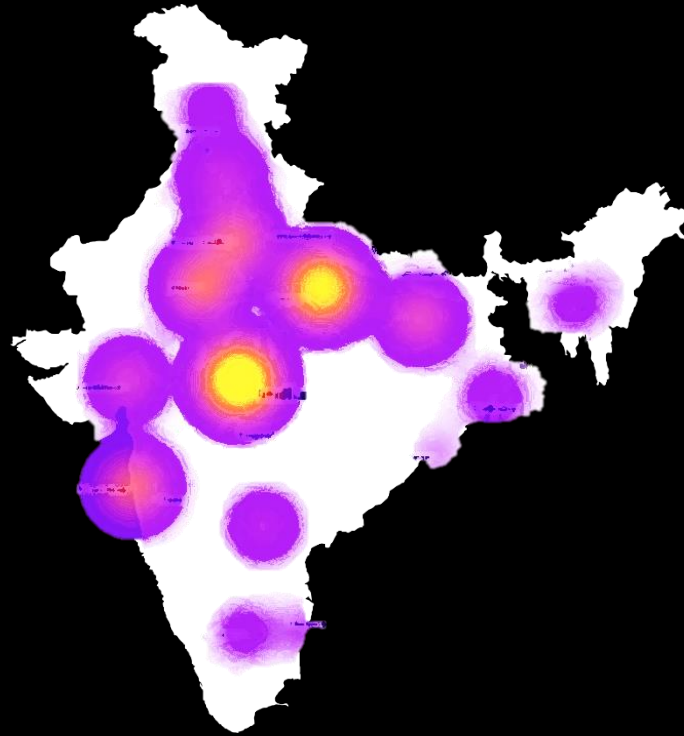
25,000 calls

5,400 messages

140,000 votes

200,000 playbacks

Avg. call: 5 mins



50% rural residents

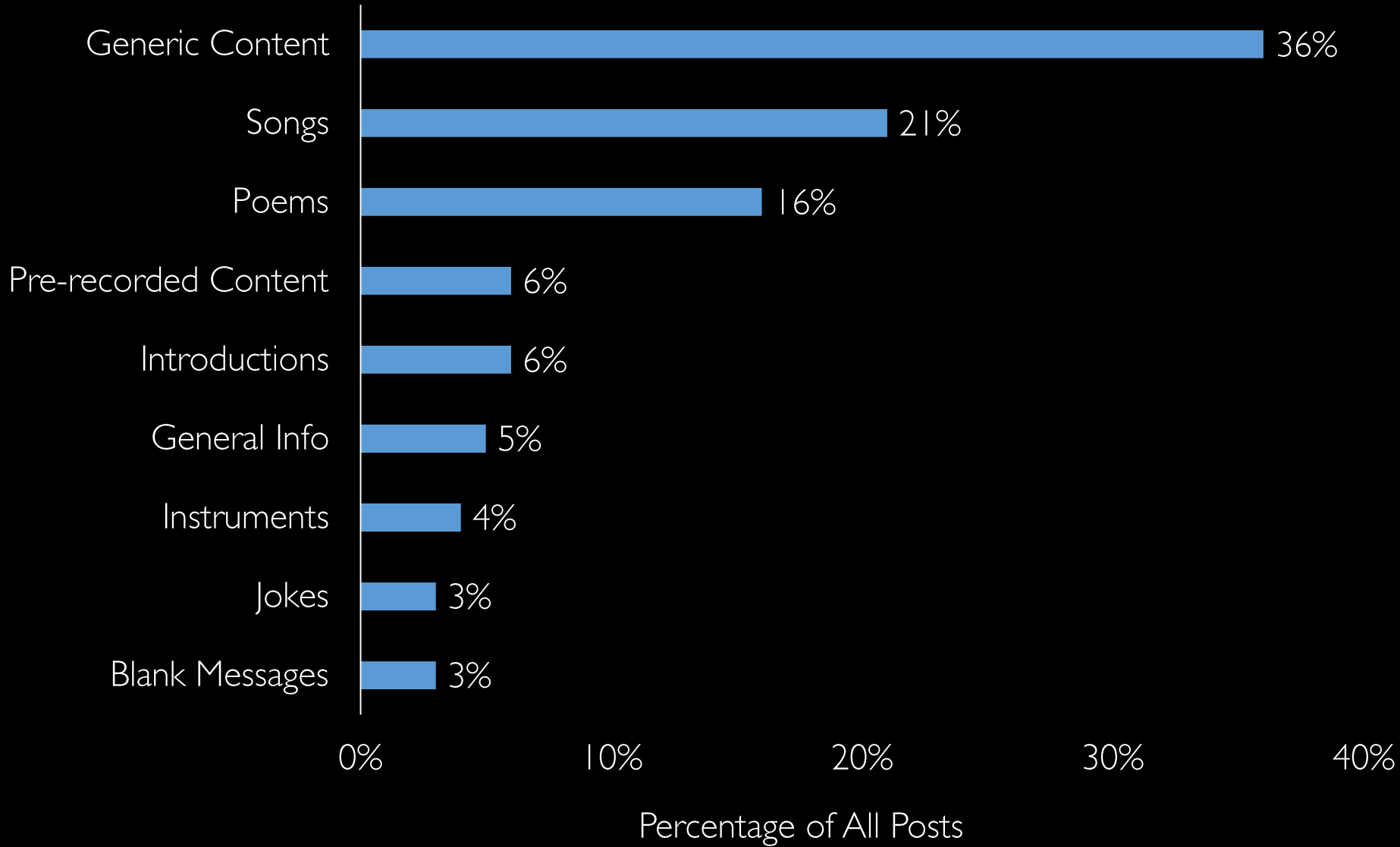


94% men



26%+
blind people

Did Users Value the Community?



Did Users Value the Community?

Impassioned Usage by Blind People

Do they derive same benefits from using mainstream social media platforms?



More barriers beyond the basic hurdles of literacy, language, poverty, and connectivity



No training

Inaccessible



Problems with Screen Reader Software

Did Users Value the Community?

User's valued their interactions with the community members!

Community Moderation Evaluations and Results

3,700 tasks
93% response rate
98% accuracy

Top-ranked vs. Bottom-ranked → 90% agreement

Categorization
tasks

Distinction b/w high &
low ranked messages

Comparison with
experts

Understanding users'
perceptions

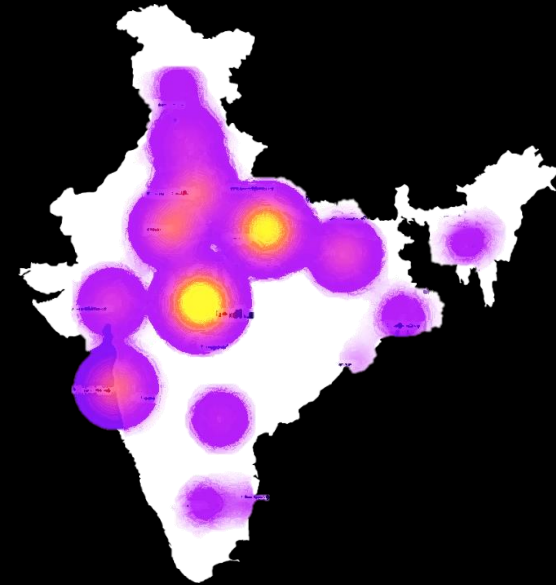
	Song	Joke	Poem	Misc
Top 50	16	7	23	4
Bottom 50	10	0	2	38

Understood ✓

Satisfied ✓

Two Significant Contributions

- 1 Built the first community-moderated voice-based social media service that connected people, gave them information, and provided them digital equity
- 2 Demonstrated that low-income low-literate people, rural residents, and blind people can moderate their digital community without any outside support



Baang service in Pakistan
Quarter million calls, messages, and votes

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Scale

- Content Moderation
- Financial Sustainability
- Misinformation

Broader Impact

- Measurement
- Replicability
- Inclusivity

Small-group Activity 2

Discuss ways to address the financial sustainability challenge of voice forums. In other words, how can you reduce the cost of voice calls?

Strategies to Manage the Cost of Voice Calls

Use advertisements



KKT service by HUL in India
(\$4.8B revenue conglomerate)

Partner with MNOs and govts



3-2-1 service in Africa

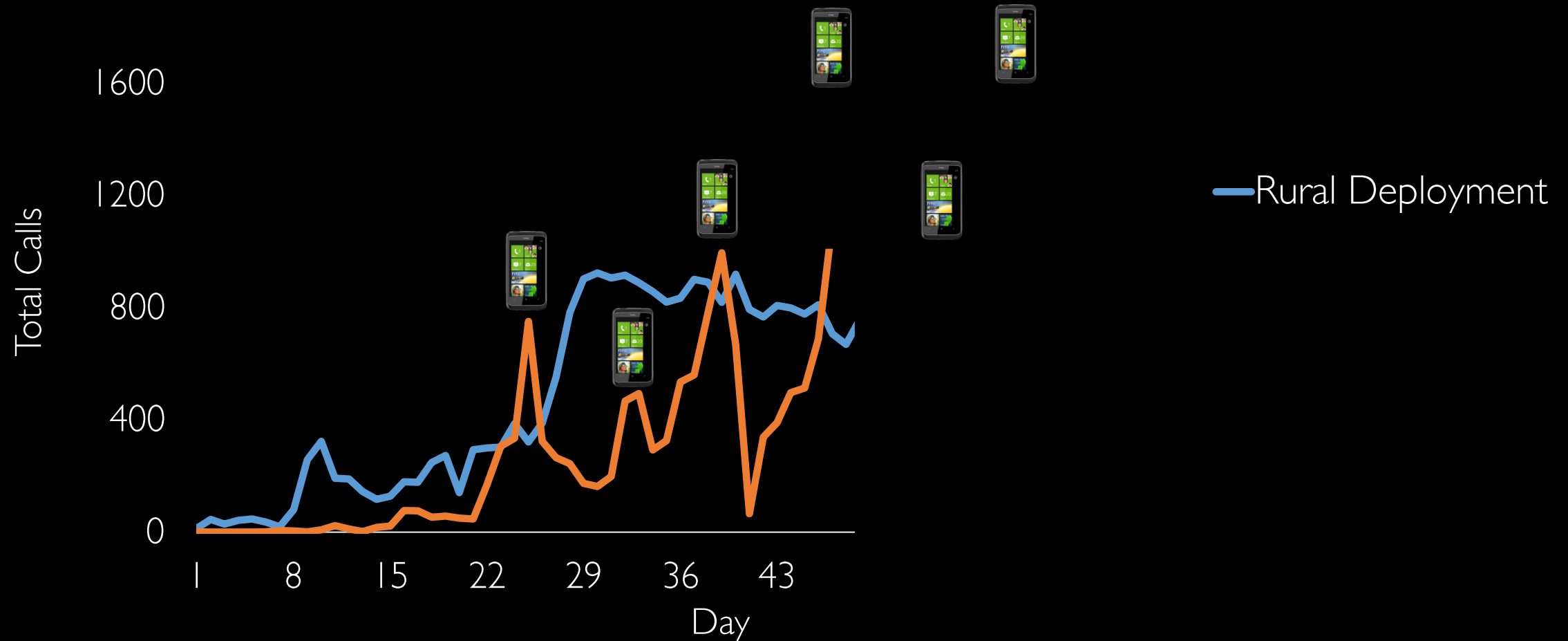
Grant Funding



CGNet Swara service in India

Infeasible, Unpredictable, Unsustainable

Can incentives prompt people to pay for voice call costs?



Can we use data channel instead of voice channel?



Record a message

Record a message and a photo

Listen to messages

 internet.org
by facebook



Only a few users of these services own a smartphone and use the Internet

Key Idea: Using Profits from Crowd Work to Address the Financial Sustainability Challenge

RQ: Can users complete useful work on their mobile phones to get free airtime to use these services?

7 Million Workers in \$5 Billion Gig Economy

amazon mechanical turk  CrowdFlower

Inappropriate for people who are illiterate or who do not have connectivity

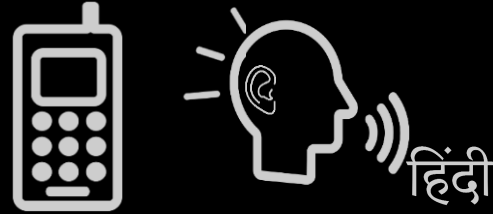
Ambitious Goal

How can I provide earning opportunities to illiterate people and basic mobile phone users?

New Crowdsourcing Marketplace



New Crowdsourcing Marketplace



What is a compelling problem that can be **divided into voice-based microtasks** and generate **\$\$\$** ?

Speech Transcription

More than \$60 Billion Industry



Hindi Speech



मेरे प्यारे भाइयो-बहनो
इस बार जब मैं मन
की बात को लेकर आप
लोगों के सुझाव देख
रहा था तो मुझे
पांडिचेरी से

Hindi Text



High accuracy, High cost



High accuracy, High cost



Low accuracy, Low cost

Poor accuracy or high cost for audio files
containing local languages and accents

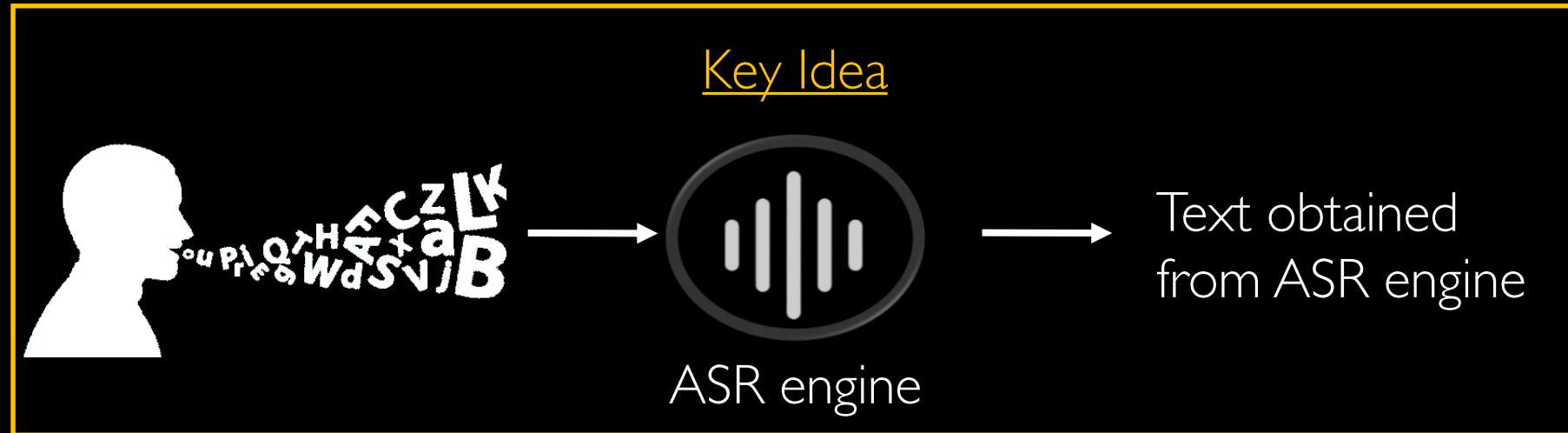
Key Idea: Using Profits from Crowd Work to Address the Financial Sustainability Challenge

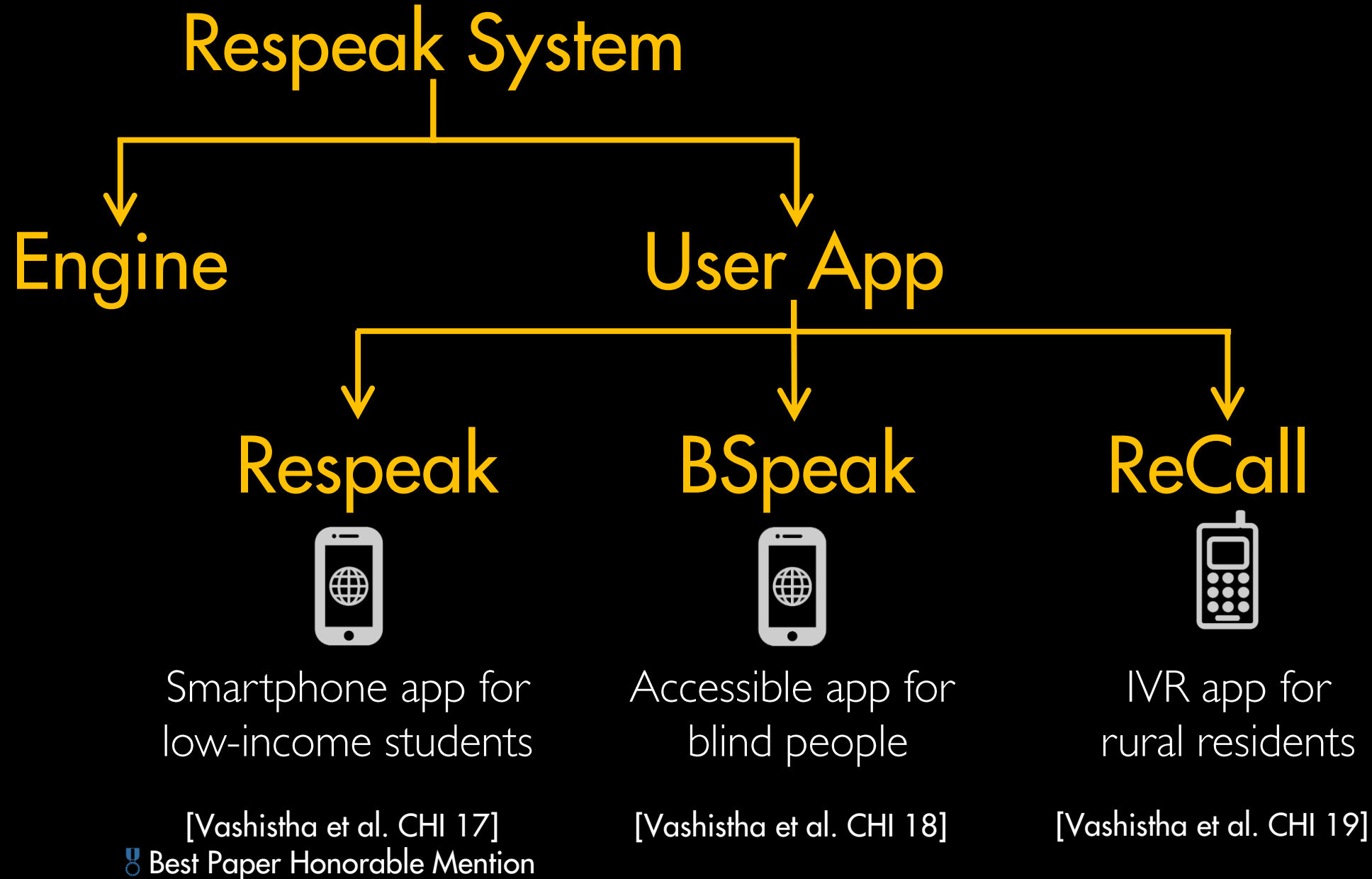
Research Goals

1. Design a **voice-based** and **basic-phone-based** crowdsourcing marketplace
2. Facilitate transcription of low-resource languages and accents
3. Generate profits to provide earnings and free airtime to users

Respeak System

Combining Benefits of Human Intelligence and ASR Systems





Respeak's Design – The Engine

Step 1: Segmentation

 Large audio file

They changed their minds because they observed how the Olympic Games were working in Rio. We had security for people in the Olympic Park.we had efficient public transportation.

Step 2: Distribution to App users

 Short audio segments

They changed their minds because they



observed how the Olympic Games were working in Rio

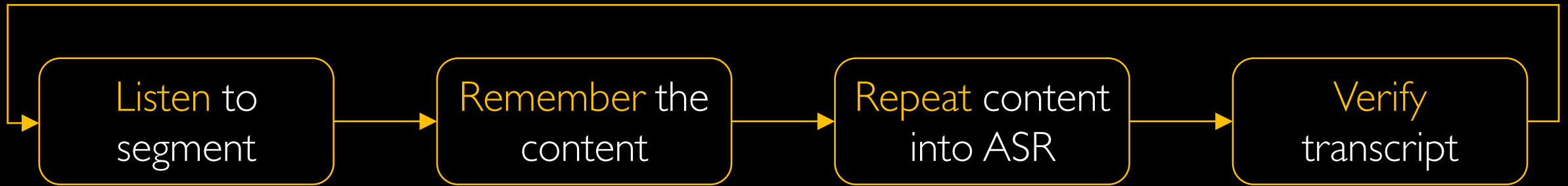


We had security for people in the Olympic Park



Respeak's Design – the Smartphone and Basic Phone App

Step 3: User perform tasks



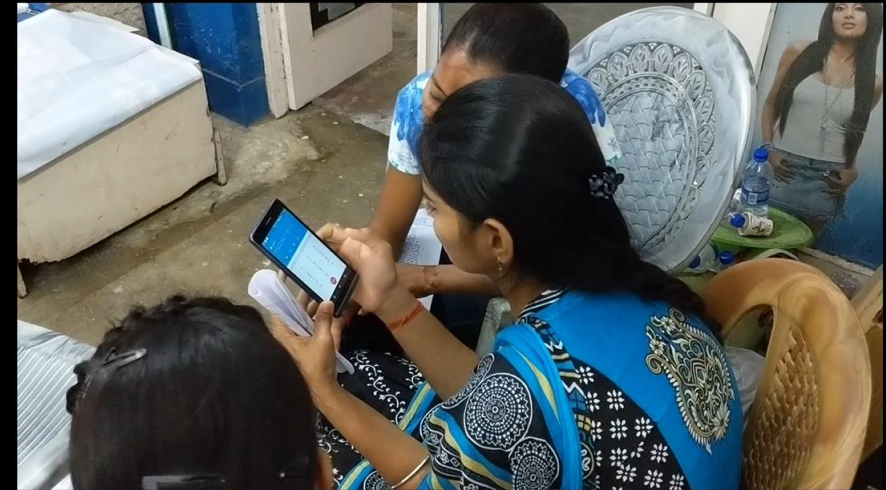
Respeak's Design – the Smartphone and Basic Phone App

Step 3: User perform tasks

A blind user using the smartphone app

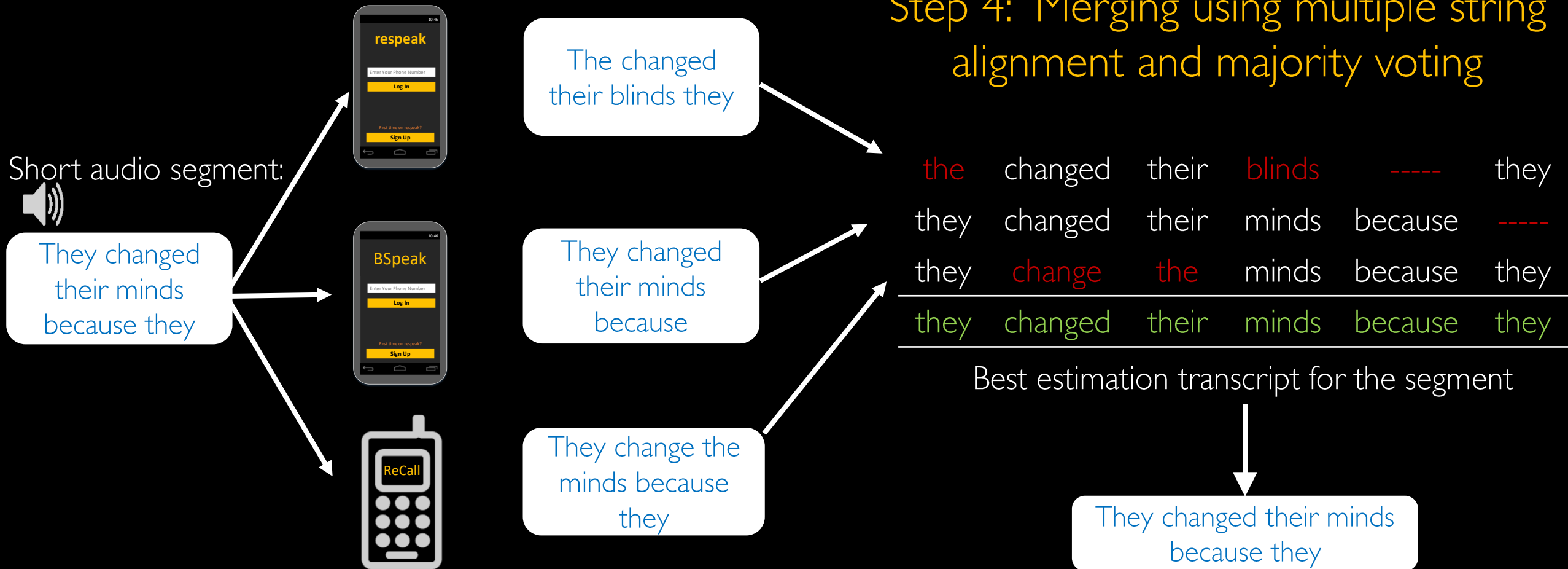


Women using the IVR app

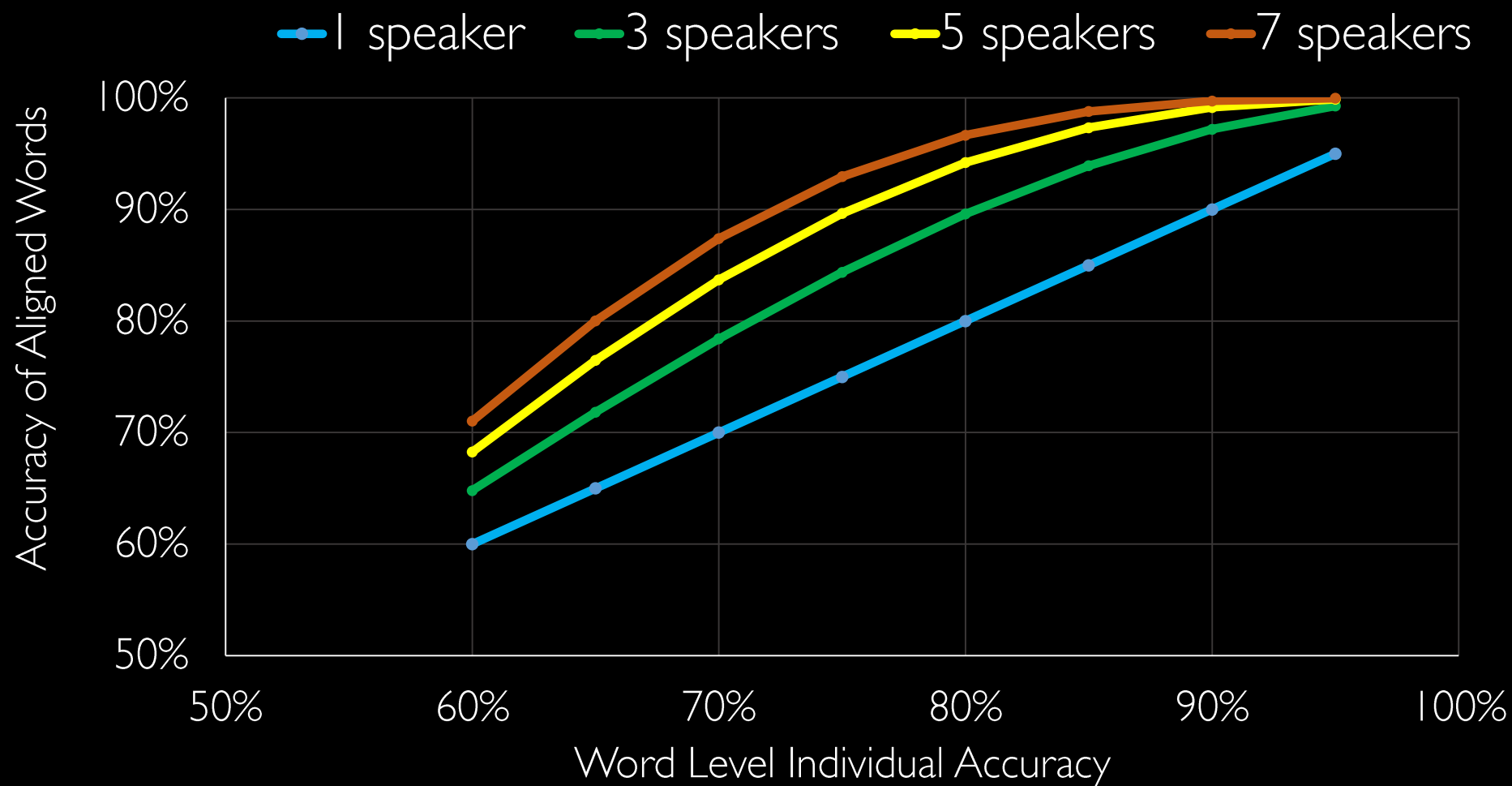


Respeak's Design – The Engine

Transcripts generated by re-speaking the segment



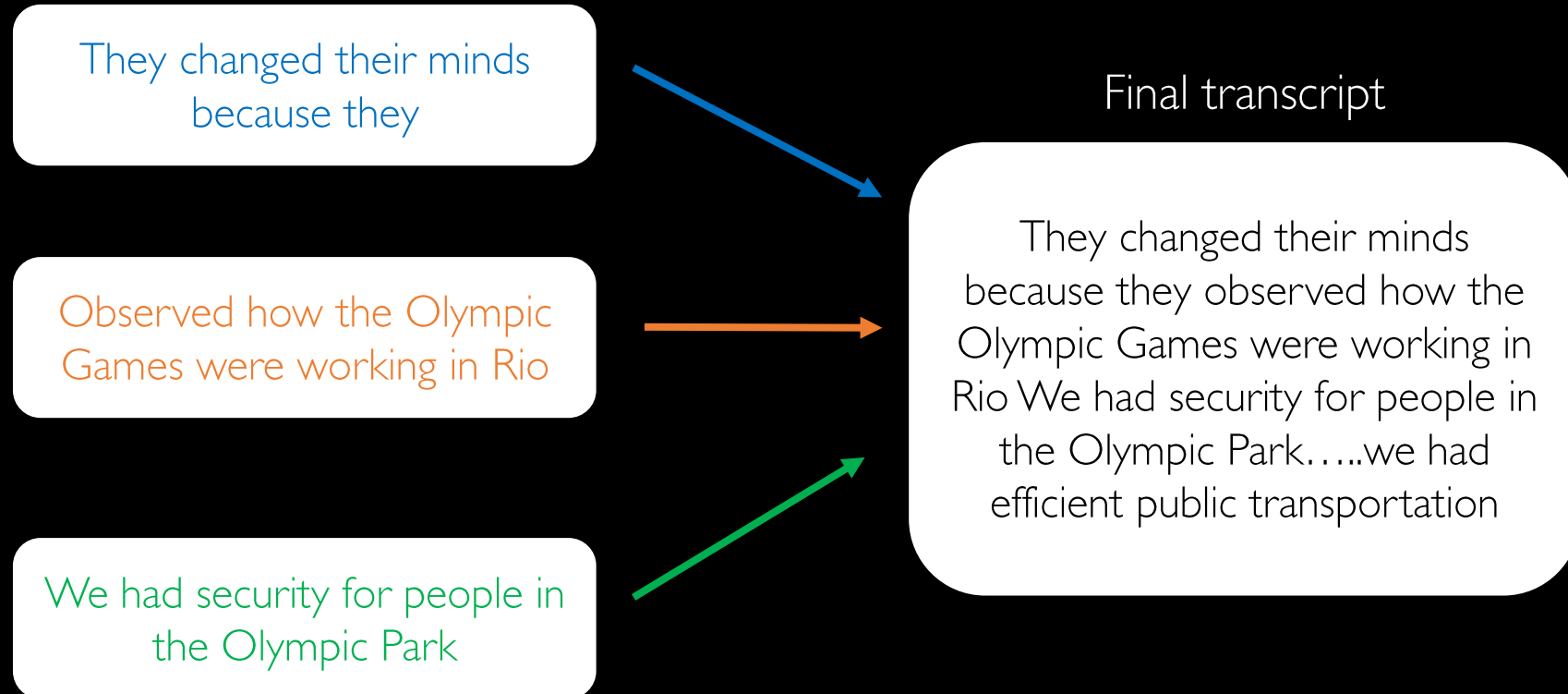
Expected Improvement in Accuracy from Majority Voting



Respeak's Design – The Engine

Step 5: Final merging

Best estimation transcripts for different segments



Cognitive Experiments, Usability Studies, Experimental Evaluations

with 67 low-income students, blind people, & rural residents

Listening

smart or basic phone?



data or voice?



Remembering

segment length?

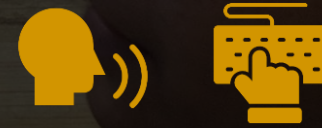


sequential or random?



Re-speaking

speaking or typing?



phone type? data or voice?

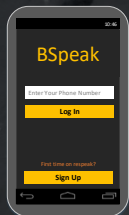


Verifying Transcript

reading or listening?

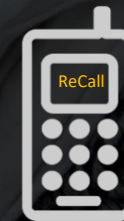
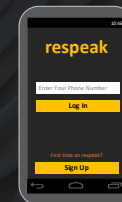


Accessibility & Usability Comparison



amazon mechanical turk

Usability & Performance Comparison



Field Deployments with 73 Low-Income Indian People

Five hours of Hindi content → 4,124 micro tasks

Respeak

25 students
1 month

BSpeak

24 blind people
2 weeks

ReCall

24 rural residents
2 weeks

Users completed 50,000 micro-tasks and earned ₹31,000 (\$470)



ASR Accuracy
71%



Transcription Accuracy
92%



Transcription Cost
\$1.30 per minute

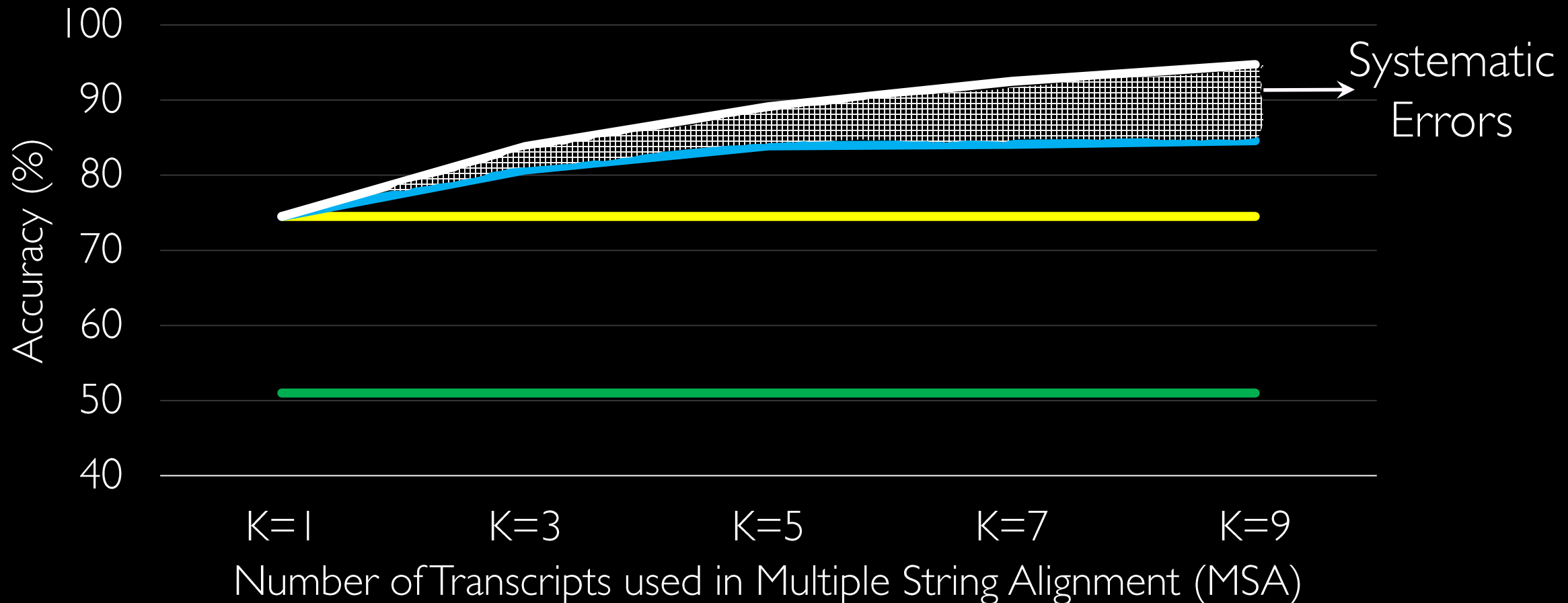


User Earnings
₹50 per hour

\$1 = ₹66

Benefits of Re-speaking and Multiple String Alignment

Graph for a challenging audio segment containing speech



Compared to sighted users, blind users...

completed
3x
more tasks

earned
2.5x
more money

with
14%
less accuracy

at
1.5x
cost

“I am grateful to you for creating the app. I **earned money for the first time** and learned the value of each rupee.”

Lower
language skills

Tasks sent to more
people because of
poor accuracy

Compared to urban users, rural users...

completed
5x
more tasks

earned
7x
more money

with
3%
less accuracy

at
2.2x
cost

“Laborers work 9 hours a day to earn ₹2,500 per month. They can use ReCall for just 2 hours daily to earn the same amount”

Cost of calls to use the ReCall IVR app

Earnings
+

“ReCall improved my pronunciation as I was speaking words carefully to get them recognized”

Can Profits from Crowd Work Address the Financial Sustainability Challenge?

Users' Earnings

₹36 per hour

Free Airtime

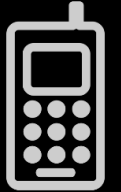
8 hours

all profits → ₹111 per hour

Integrated ReCall with Sangeet Swara!

Three Significant Contributions

1 Built the first voice-based crowdsourcing marketplace for illiterate people and basic mobile phone users



2 Demonstrated that low-income students, blind people, and rural residents can vocally transcribe audio files



3 Showed that the profits from crowd work can provide earnings as well as airtime to users, thereby addressing the financial sustainability challenge

₹111/hour



Strong Commercialization Interest by Social Enterprises

Challenges of Voice-based Social Computing Services

Adoption

- Training users
- Spread
- Retaining users

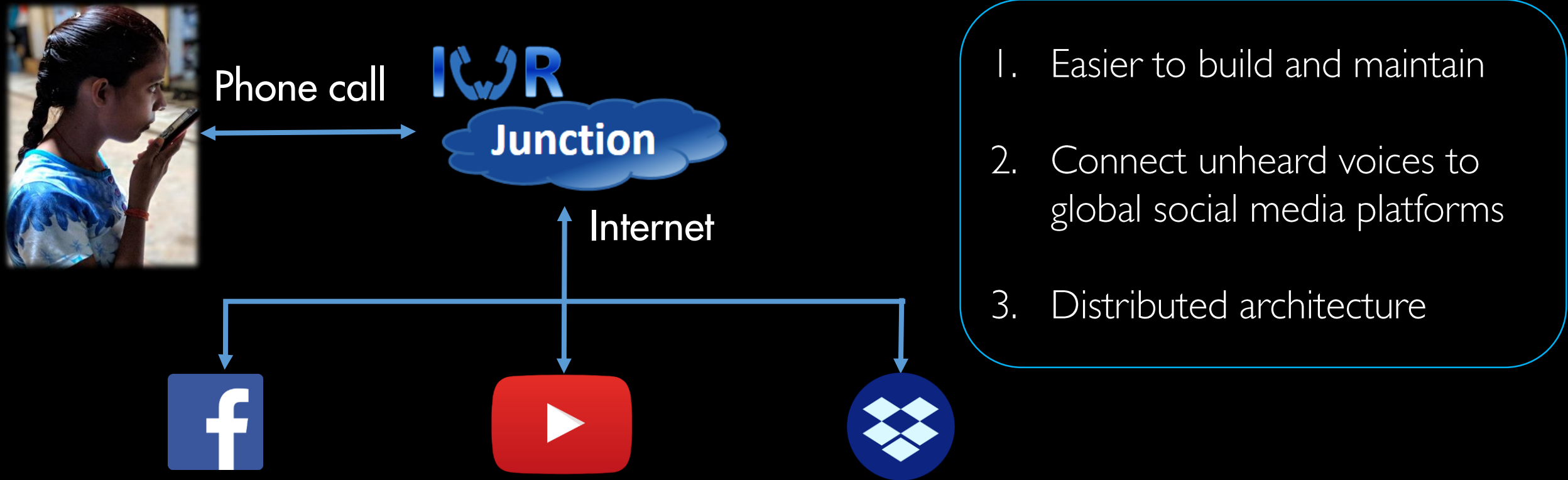
Scale

- Content Moderation
- Financial Sustainability
- Misinformation

Broader Impact

- Measurement
- Replicability
- Inclusivity

Key Idea: A Toolkit to Create Replicable and Connected Voice-based Social Computing Services



- 1. Easier to build and maintain
- 2. Connect unheard voices to global social media platforms
- 3. Distributed architecture

More than 110,000 Phone Calls from 25,000 Users

Government of Somaliland



Picture credit: Fiona Graham

Connecting rural people and government officials

Voice of America in Mali



Distributing and gathering news in low-resource regions

Women's rights activists in India



Picture credit: Reuters

Giving voice and digital identity to protestors

[Gulaid and Vashistha ICTD 13]

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Low Participation of Women on Voice-based Services

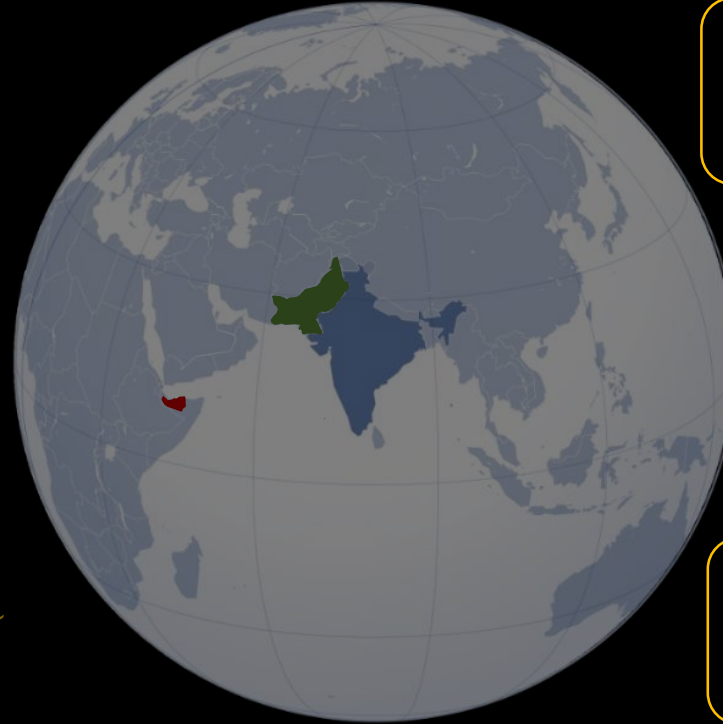
Polly in Pakistan
Women: 11%

Baang in Pakistan
Women: 12%

Ila Dhageyso in Somaliland
Women: 15%

CGNet Swara in India
Women: 10%

Sangeet Swara in India
Women: 6%



Why the participation of women is almost non-existent on these voice-based social computing services?

Why the participation of women so low in Swara & Baang?

Mixed-methods Approach

Content Analysis: 10,361 audio messages (~140 hours)

— content type, gender, targeting women, abusive?

Usage Analysis: 857 users

— what users liked, disliked, shared, and reported

Surveys and Interviews: 50 users

— user experience, perceptions, as well as benefits and limitations of these services

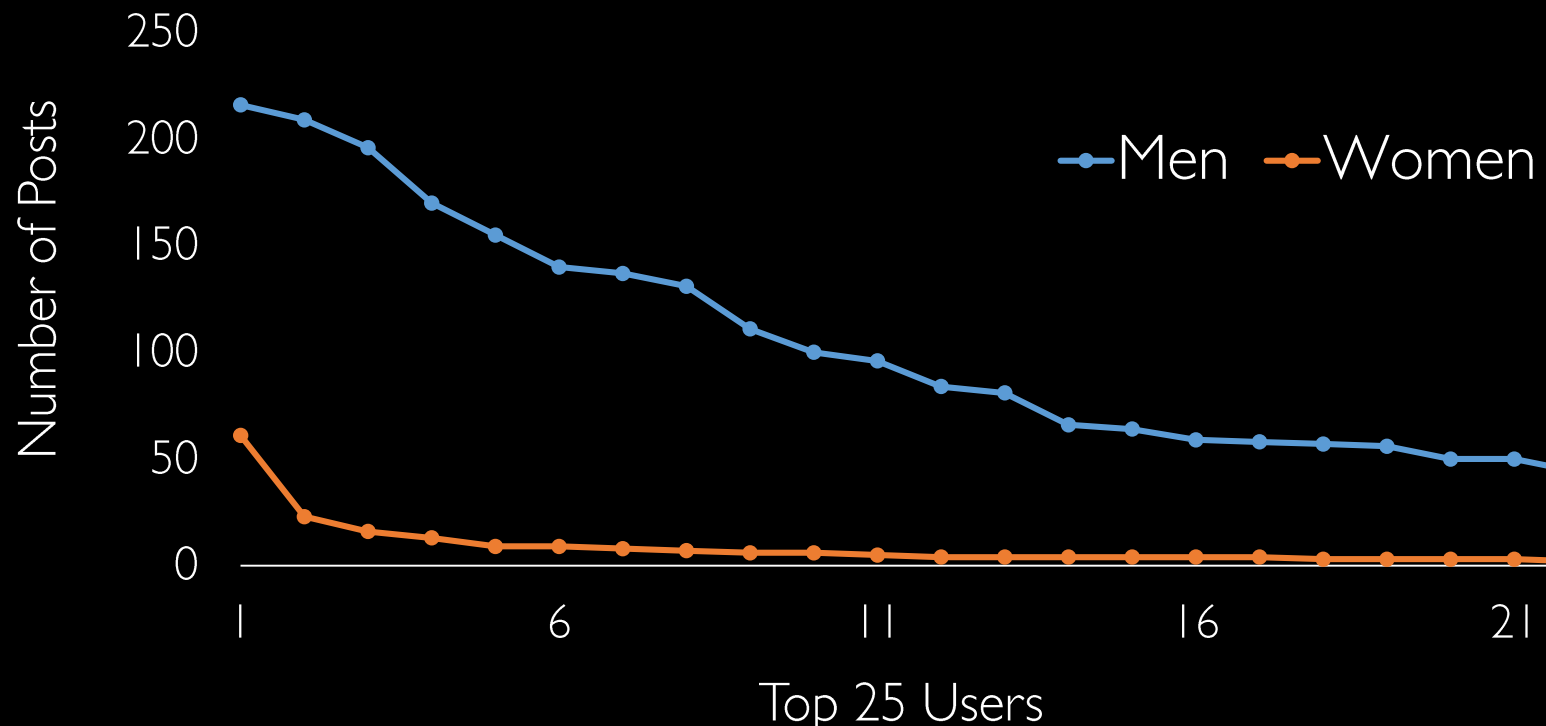
Swara in India

Baang in Pakistan

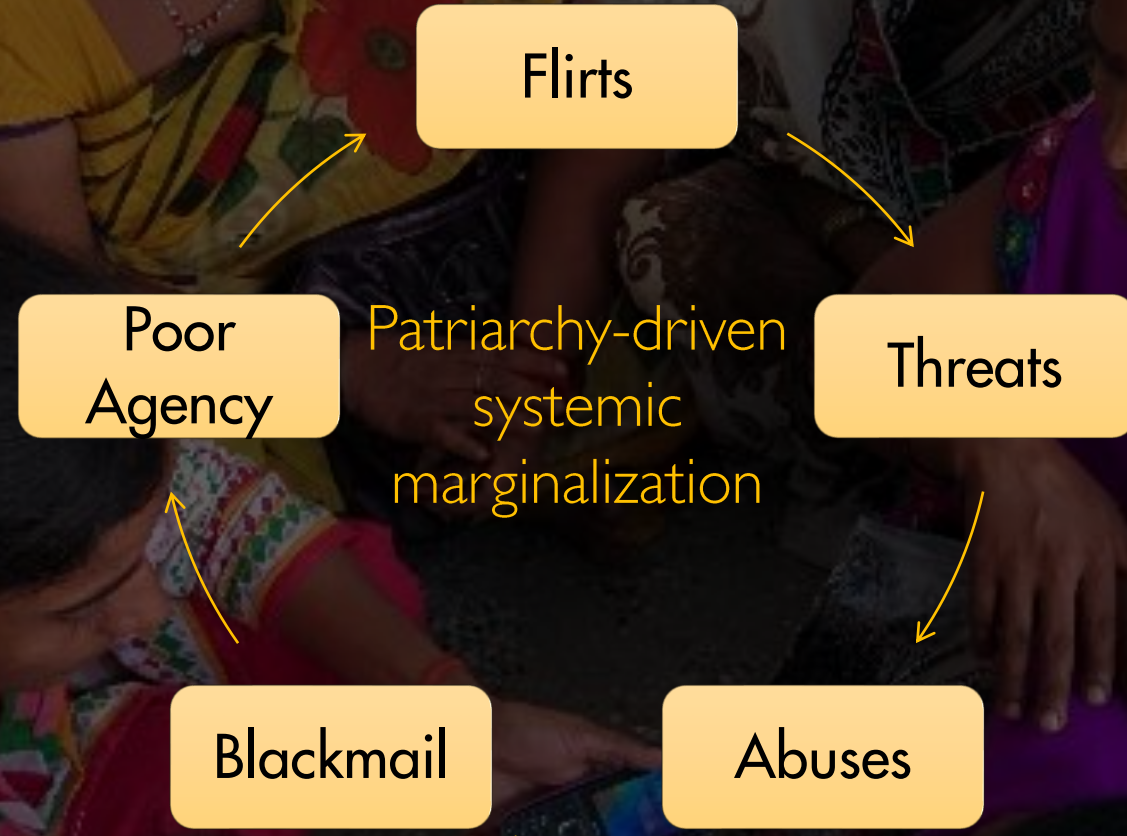


5%
messages

6%
messages



Low Participation of Women on Social Computing Services



Posts directed at women
98% of flirty
62% of threatening
46% of abusive messages

Implications

Need to *go beyond access and connectivity* when thinking of solutions in low-resource environments

Marginalities *within* marginalities

Small-group Activity 3

Discuss how can you make voice forums like Sangeet Swara more welcoming and safe for women?

Combating Harassment and Misinformation on Social Computing Systems

Information
Retrieval

Public Policy

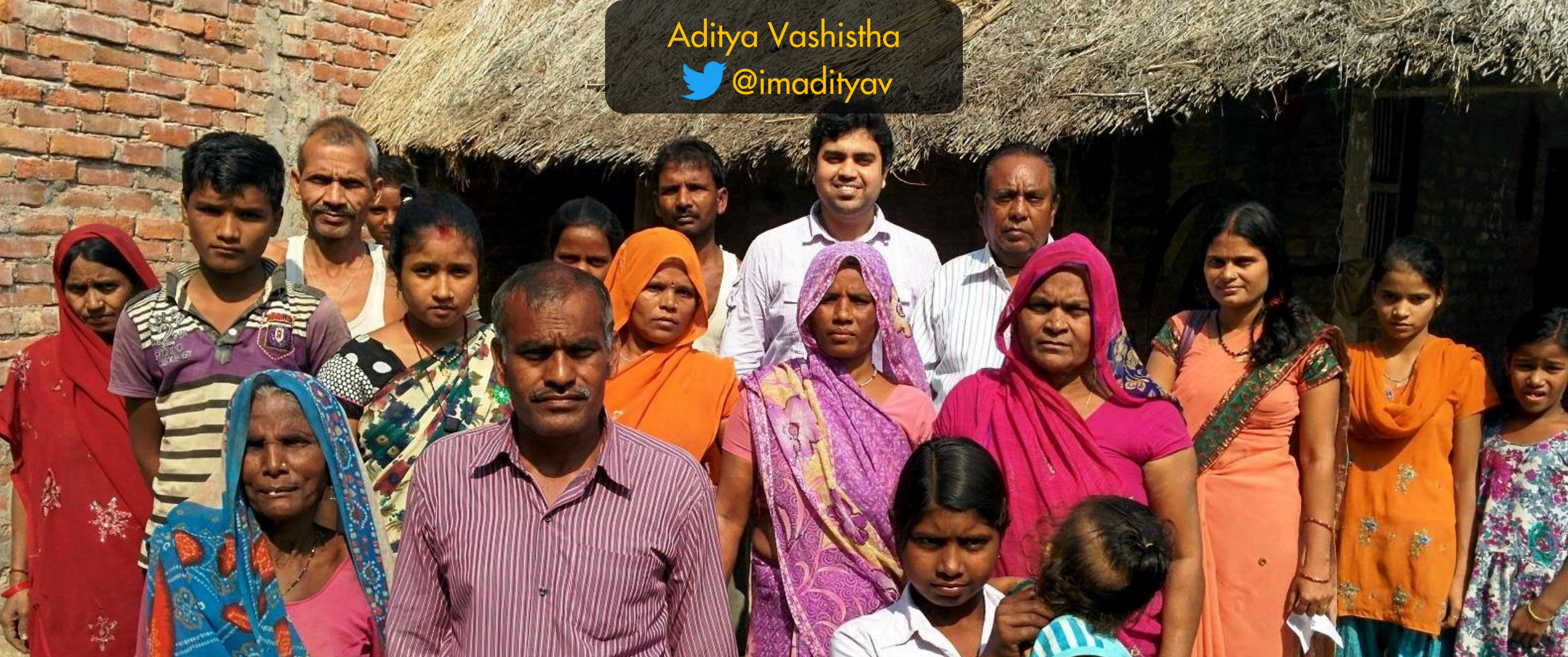
Machine
Learning

RQ: How to address situations where the collective ignorance of community members eclipse their collective intelligence?

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@imadityav



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